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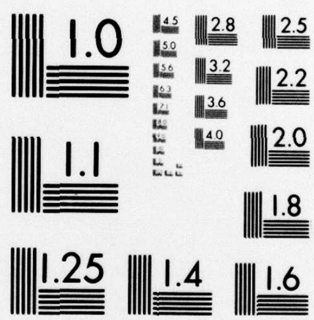

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COMMUNICATION APPLICATION OF ADAPTIVE ARRAYS

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Naval Air Systems Command
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This report describes progress under Naval Air Systems Command Contract N00019-79-C-0291 during the second quarterly period. Research on adaptive arrays for communication applications is summarized.

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CONTENTS

I. INTRODUCTION

This report describes progress under NASC Contract N00019-79-C-0291 during the second quarterly period. There are three areas of work under this contract. The first involves studies on weight jitter and dynamic range for the improved LMS loop. The second is a continuation of research on a reference signal generation technique for FSK signals. The third area involves the preparation of a monograph on adaptive arrays.

II. PROGRESS

(1) The Improved LMS Loop

During this quarter, studies and computer simulations have continued on the improved loop [1]. Recent effort has been concentrated on the problem of weight jitter in the new loop. Simulations have been done for a loop with both a finite time average and a simple low-pass filter to determine weight variance as a function of signal power and other parameters. It turns out that long computer running times are required to obtain accurate data. Hence, only a limited amount of data has been collected. However, these data will serve as a base for comparison with theoretical results.

Although our work on weight jitter is not yet complete, the results indicate weight jitter is well behaved with the new loop. It appears that the modifications made to the LMS loop to control time constant also control weight variance, so the variance also does not increase indefinitely with signal power. Work is continuing in this area.

(2) Reference Signal Generation with FSK Signals

Work on the adaptive array for FSK signals has continued with more study of the reference signal generation loop. The loop uses a bit prediction technique to process the array output and produce the reference signal. Computer simulations and mathematical calculations have been used to study the array performance as a function of loop parameters and bit prediction errors.

The major loop components are a pair of mixers, a limiter, and a bandpass filter. Computer simulations have shown that the unwanted mixer products have little effect on array performance. It has also been found that the limiter must be a soft limiter for proper interface suppression. Study of the amplitude and phase transients in the bandpass filter has demonstrated that transients should be kept shorter than one fourth of the bit interval.

Simulations showing the effects of bit prediction errors have verified earlier calculations. Without interference, an increase in prediction errors causes the average value of each weight to be scaled down by the prediction factor. The relative antenna pattern remains the same. With interference present, the weights have upper and lower bounds set by the signal and interference directions. As prediction errors increase, the weights tend to move away from their optimum values. Simulations show that the array is able to lock onto the desired signal in the presence of cw interference with prediction errors as high as 40%.

(3) The Adaptive Array Monograph

Work on the adaptive array monograph is proceeding. The process of organizing an overall presentation of adaptive arrays, however, has brought to our attention several areas where we have inadequate information on array performance. For this reason, work on the monograph has sometimes been interrupted in order to develop the additional material needed.

Specifically, we have done a study of the effect on array performance of an error in pointing direction with a steered-beam array. The results of this study have been written up as a paper[2], and these results will be used directly in the monograph.

A second area where little information is available is the effect of element patterns and signal polarization on array performance. In order to have something to use in the monograph, a few illustrative problems have been worked out. First, a paper has been written on the effects of dipole element patterns on grating nulls[3]. Second, two additional papers are being prepared on the effects of signal polarization with simple crossed dipole arrays. All of these results will be incorporated in the monograph.

III. REFERENCES

1. R. T. Compton, Jr., "An Improved Feedback Loop for Adaptive Arrays," to be published in IEEE Transactions on Aerospace and Electronics Systems.

2. R. T. Compton, Jr., "Pointing Accuracy and Dynamic Range in a Steered Beam Adaptive Array," submitted to IEEE Transactions on Aerospace and Electronic Systems.

3. A. Ishide and R. T. Compton, Jr., "On Grating Nulls in Adaptive Arrays," submitted to IEEE Transactions on Antennas and Propagation.